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EXAMINER	
JUBA JR, JOHN	
ART UNIT	**PAPER NUMBER**
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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 10/656,342	Applicant(s) LUDWIG, LESTER F.
	Examiner John Juba, Jr.	Art Unit 2872

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-43* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-43* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *04 September 2003* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *12/15/2003*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Information Disclosure Statement

With Applicant's I.D.S. of December 15, 2003, all of the references considered during prosecution of parent application serial number 09/512,781 have been considered.

Drawings

The drawings are objected to under 37 CFR 1.83(a). The drawings must show every feature of the invention specified in the claims. Therefore, the first optical element, second optical element and positive-definite optical transfer function element arranged to comprise "an integrated optics device" (claims 14 and 35) and a "monolithic, integrated optics device" (claims 15 and 36) must be shown or the feature(s) canceled from the claim(s). *No new matter should be entered.*

A proposed drawing correction or corrected drawings are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

Specification

The disclosure is objected to because of the following informalities. Appropriate correction is required:

In paragraph [0006] (third sentence), "positive-define" should read "positive-definite".

In paragraph [0028] (sixth sentence), "Fourier plane **103**" should read "Fourier plane **104**".

In paragraph [0031], "transform element **104**" should read "transform element **103**".

The specification has not been checked to the extent necessary to determine the presence of all possible minor errors. Applicant's cooperation is requested in correcting any errors of which applicant may become aware in the specification.

Claim Objections

Claim 40 is objected to because of the following informalities. Appropriate correction is required:

Claim 40 purportedly further recites elements of the method without introducing any additional active method *steps.*

Editorially, the examiner notes that claims 23 – 28 are written in the passive voice ("is determined"), as are claims 30 ("is controlled") and 31 ("are accomplished"). Since each of these claims purportedly further limit a series of active steps recited in claim 22, it would be appropriate to recite the additional limitations in the active voice.

Claim Rejections - 35 USC § 112

The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claims 17 and 38 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the enablement requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention.

As depending from claim 1, claim 17 recites a first optical element adapted to receive an original image, wherein said original image comprises a particle beam. As depending from claim 22, claim 38 recites receiving an original image at a first optical element, wherein said original image comprises a particle beam. However, there is no disclosure of an "optical element" receiving a particle beam and no disclosure of what manner of "optical element" would be suited for receiving a particle beam as recited. By definition, optical elements operate on optical waves, not particle beams. Thus, it is believed that one of ordinary skill would be left to undue experimentation to identify an "optical element" suitable for receiving a particle beam.

Similarly, as depending from claim 1, claim 17 recites a positive-definite optical transfer function element that introduces a non-positive-definite transfer function on said original image, wherein said original image comprises a particle beam. As depending from claim 22, claim 38 recites positioning a positive-definite optical transfer function element that introduces a non-positive-definite transfer function on said original image, wherein said original image comprises a particle beam. However, there is no disclosure of a structure suitable which acts as a positive-definite transfer function element for particle beams. Thus, it is believed that one of ordinary skill would be left to undue

experimentation to identify particle beams exhibiting wave behavior and the corresponding spatial filter suitable for practice of the invention.

The only disclosure of particle beams appears to be passing mention of "particle beam systems", (possibly) "radiation accelerators" (para. [0002]), and CRT's (para. [0024]). From this disclosure, the examiner finds enablement for the transform system wherein an image may be written on a CRT by particle beam (e^--beam), so as to be transformed to the optical regime for further processing. However, this is not the disclosure of an optical element operative on the particle beam *itself*, as it is believed the claims recite.

Claims 17 and 38 rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Claims 17 and 38 recite an optical element receiving an original image, and recite a positive-definite transfer function operating on an original image, wherein the original image comprises a particle beam. However, the only disclosure of a particle beam associated with an original image appears to be that of an electron beam within a CRT to produce an optical image. Thus, it is believed that the claims are incorrect in reciting that the original image comprises a particle beam. Rather, it is believed that the claims are directed to an optical element adapted to receive an original optical image and a positive-definite transfer function element that introduces a non-positive-definite transfer function on an original optical image, wherein the original optical image is generated by a particle beam.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claim 43 is rejected under 35 U.S.C. 102(b) as being anticipated by Ozaktas, et al (newly cited *JOSA A* 11(2)). In the context of the present specification, it is not clear that the expression "Fourier transform plane" specifically refers to a first order Fourier transform plane. It will be appreciated that a segment of quadratic gradient index medium comprises a virtually infinite number of fractional Fourier transform planes of infinitesimal width along its length. Thus, referring *initially* to their Section 7, Ozaktas, et al disclose an optical filtering method comprising the steps of

receiving an original optical signal requiring filtering at a first optical element (GRIN segment);

[arranging a second optical element (second GRIN segment) with respect to the first optical element];

inducing a plurality of non-first-order Fourier transform planes of infinitesimal width *within the optical region defined by the second optical element* positioned relative to the first optical element, said optical region comprising a particular *non-first-order* Fourier transform plane and a plurality of regions outside said particular *non-first-order* Fourier transform plane; and

introducing a non-positive definite transfer function on said original optical signal using a positive-definite optical transfer function element (amplitude mask) position with said region outside said non-first-order Fourier transform plane (*i.e.,* at the end of the first GRIN segment), wherein said introducing of said non-positive definite transfer function results in a filtered manifestation of said original optical signal. Although the optical signal appears to be of substantially no spatial extent, it nonetheless constitutes an "image" of its source, within the specificity recited. Further, although Ozaktas, et al first disclose a non-space-variant embodiment, they clearly disclose a *non-illustrated* embodiment consisting of "several masks sandwiched between segments of quadratic GRIN medium" whereby "binary amplitude masking in a few fractional Fourier domains in cascade may enable one to eliminate noise quite conveniently" in conventional space-spatial frequency domains (non-spatially-invariant applications; see §11, CONCLUSION). The examiner believes that the two-dimensional non-spatially-invariant signal of Ozaktas, et al fairly constitutes an "image" in at least the broadest reasonable sense.

Insofar as the kernel of the fractional Fourier transform applied by Ozaktas, et al is a complex-valued function or can be decomposed into a set of complex-valued functions, it is believed that multiplication with a non-complex-valued (amplitude) mask *inherently* gives rise to a non-positive-definite (varying phase) transfer function, as recited.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1 - 3, 12, 13, 16, 18, 22 – 24, 33, 34, 37, 39 and 43 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ozaktas, et al (newly cited *JOSA A* 11(2)), in view of Bernardo, et al (*JOSA A* 11(10); Applicant's reference "C5") and Ozaktas, et al (*JOSA A* 10(12); Applicant's reference "C34"). Beginning with claim 43, and as set forth above, the examiner believes Ozaktas, et al(*JOSA A* 11(2)) disclose the invention within the specificity recited. However, to the extent that *it may later be held* that the expression "Fourier transform plane" must be read as particularly meaning *classical (zero and ±1st order) Fourier cases of the fractional Fourier transform*, then Ozaktas, et al (*JOSA A* 11(2)) disclose the invention substantially as claimed, but do not disclose (with respect to claim 43) the step of inducing a classical Fourier transform plane within an optical region defined by the second optical element, and do not disclose (with respect to claims 1 and 22) a classical Fourier transform plane in an optical region defined *between* the first and second elements.

In the same field of endeavor, Bernardo, et al (C5) disclose optical filtering systems (*e.g.,* Figs. 6a & 6b) comprising first and second (bulk) optical elements with an optical region therebetween, wherein a classical Fourier transform plane is induced between the first and second elements and wherein said optical region comprises an

optical region outside said classical Fourier transform plane. Bernardo, et al teach that the arrangement of bulk optical lenses in this manner is equivalent to a series of GRIN segments with fractional transform planes therebetween.

Also in the same field of endeavor, Ozaktas, et al (C34) teach the equivalence of cascaded GRIN media and sandwiched spatial filters with bulk optical implementations. Ozaktas, et al teach that the bulk optics implementation may be more desirable than GRIN media, since the GRIN media "tend to have rather low space-bandwidth products" (Pg. 2250, at (1)).

It would have been obvious to one of ordinary skill in the art to replace the grin media and sandwiched positive-definite transfer function elements (amplitude "masks") of Ozaktas, et al (*JOSA A* 11(2)) with a plurality of bulk lenses with classical Fourier transform planes and masks therebetween, since the two implementations were generally art-recognized equivalents for fractional Fourier transform operations, and since Ozaktas, et al (C34) suggest that the bulk-optic implementations may offer larger space-bandwidth products than GRIN media. One of ordinary skill would have appreciated the rather obvious advantages of larger space-bandwidth products as offering greater processing capacity and facilitating processing of wide-band or high-resolution signals.

With regard to claims 2 and 23, Ozaktas, et al (*JOSA A* 11(2)) clearly teach selection of the amplitude distributions in accordance with their location with respect to the optical elements, *i.e.,* in accordance with the domain in which the filters are to be placed. Amplitude filtering in one domain is likened to compaction in that domain, and

is accompanied by spreading in an orthogonal domain. Ozaktas, et al (*JOSA A* 11(2)) teach careful selection of the amplitude distributions in their respective domains so as to prevent mixing of the desired and undesired signals corresponding orthogonal domains (see discussion of Figs. 4 & 5).

With regard to claims 3 and 24, whatever the spatial distribution of the mask, (determination of) the position of the mask is inseparably linked with the transfer functions induced in the regions outside the classical Fourier transfer plane see §8, GENERALIZED SPATIAL FILTERING). Insofar as the kernel of the fractional Fourier transform applied by Ozaktas, et al is a complex-valued function or can be decomposed into a set of complex-valued functions, it will be appreciated that such determination is made in accordance with a range of complex-valued transfer functions induced by (in) said optical region outside the classical Fourier transform plane.

Claims 14, 15, 35, and 36 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ozaktas, et al (*JOSA A* 11(2)), in view of Bernardo, et al (C5) and Ozaktas, et al (C34) as applied to claims 1 and 22 above, and further in view of Shreve (U.S. Patent number 4,280,752). As set forth above for claims 1 and 22, Ozaktas, et al (*JOSA A* 11(2)), Bernardo, et al (C5), and Ozaktas, et al (C34) disclose the invention substantially as claimed. However, these references do not disclose the combination as comprising a (monolithic) integrated optics device.

In the same field of endeavor, Shreve discloses a Fourier transform apparatus comprising optic elements and filters. Shreve teaches that integration of these

elements into a monolithic integrated optics device simplifies alignment, reduces Fresnel losses and improves immunity to dust and contaminants.

It would have been obvious to one of ordinary skill in the art to render the linear Fourier transform system of Ozaktas, et al (*JOSA A* 11(2)), Bernardo, et al (C5), and Ozaktas, et al (C34) as a monolithic integrated optics device, in the interest of simplifying alignment, reducing Fresnel losses and improving immunity to dust and contaminants, as suggested by Shreve.

Claims 8, 9, 29, and 30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ozaktas, et al (*JOSA A* 11(2)), in view of Bernardo, et al (C5) and Ozaktas, et al (C34) as applied to claims 1 and 22 above, and further in view of Pasch (Applicant's reference designation "A13"). As set forth above for claims 1 and 22, Ozaktas, et al (*JOSA A* 11(2)), Bernardo, et al (C5), and Ozaktas, et al (C34) disclose the invention substantially as claimed. However, these references do not disclose the use of a controllable modulator.

In the same field of endeavor, Pasch discloses a Fourier transform image filtering apparatus. Pasch teaches that use of a controllable modulator in the filter plane under the influence of control signals permits the apparatus to be operated in closed-loop configuration, whereby optimization of the image filtering can be placed under automated control.

It would have been obvious to one of ordinary skill in the art to replace the "masks" of Ozaktas, et al (*JOSA A* 11(2)) with controllable modulators under the

influence of control signals, in the interest of placing the filter under automated control in a closed-loop configuration, whereby the filter function could be optimized, as suggested by Pasch.

Claims 6, 7, 19 – 21, 27, 28, and 40 – 42 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ozaktas, et al (newly cited *JOSA A* 11(2)), in view of Bernardo, et al (C5) and Ozaktas, et al (C34) as applied to claims 1 and 22 above, and further in view of Kutay, et al (newly cited *JOSA A* 15(4)). As set forth above for claims 1 and 22, Ozaktas, et al (*JOSA A* 11(2)), Bernardo, et al (C5), and Ozaktas, et al (C34) disclose the invention substantially as claimed. However, these references do not disclose (with regard to claims 6, 7, 25, and 26) "approximation", and do not disclose (with regard to claims 19 – 21 and 40-42) an opto-electronic image source or observation element.

In the same field of endeavor, Kutay, et al (*JOSA A* 15(4)) disclose a method of image filtering in a fractional Fourier domain (*e.g.,* §4). Kutay, et al teach that the appropriate restoration kernel m_{6pt} to be applied in the fractional domain can be identified by first estimating the result (Eqn. (10)) of applying the kernel to the undistorted image, and solving numerically to find the optimum operator. The approximation relies upon correlation functions in particular locations (domains).

It would have been obvious to one of ordinary skill in the art to estimate the location and amplitude distributions of the masks of Ozaktas, et al (*JOSA A* 11(2)), in the interest of providing a logical starting point for numerical solution, as suggested by Kutay, et al (*JOSA A* 15(4)).

With regard to claims 19 – 21 and 40 – 42, Kutay, et al teach that image restoration of such a nature can be implemented with "the same kind of hardware as that of the ordinary Fourier transform" (first column on Pg. 828). The examiner takes Official notice that opto-electronic transducers were well-known image sources and observation devices for use in optical implementations of Fourier transform filtering. That is, it is believed that one of ordinary skill would at once envisage the image restoration apparatus as comprising an opto-electronic transducer as the image source and an opto-electronic transducer as the observation device, since these were well-known as convenient means to convey data to and from a storage device to the optical processor for both real-time and post-processing of data.

Claims 6, 7, 10, 11, 27, 28, 31, and 32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ozaktas, et al (newly cited *JOSA A* 11(2)), in view of Bernardo, et al (C5) and Ozaktas, et al (C34) as applied to claims 1 and 22 above, and further in view of Erden, et al (newly cited *JOSA A* 15(4)). As set forth above for claims 1 and 22, Ozaktas, et al (*JOSA A* 11(2)), Bernardo, et al (C5), and Ozaktas, et al (C34) disclose the invention substantially as claimed. However, these references do not disclose (with regard to claims 6, 7, 25, and 26) "approximation", and do not disclose (with regard to claims 10, 11, 31, and 32) optical computing with complex-valued arithmetic.

In the same field of endeavor, Erden, et al (*JOSA A* 15(6)) disclose a method of identifying an appropriate filter for repeated filtering in a fractional Fourier domain (*e.g.,* § 3 D.). Erden, et al teach that the appropriate filter kernel to be applied in the fractional

domain can be identified by first estimating the filters, and solving numerically to find the optimum operator.

It would have been obvious to one of ordinary skill in the art to estimate the mask positions and amplitude distributions in the masks of Ozaktas, et al (*JOSA A* 11(2)) since Erden, et al teach that this is a natural starting point for numerical optimization.

With regard to claims 10, 11, 31, and 32, Erden, et al suggest that such filtering systems are equally well-suited for operation on two-dimensional data for complex-valued arithmetic (matrix algebra). Thus, it would have been obvious to provide the image of the prior art in the form of data for optical computing, since Erden, et al teach that the systems are also useful for matrix multiplication.

Claims 4, 5, 25, and 26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ozaktas, et al (*JOSA A* 11(2)), in view of Bernardo, et al (C5) and Ozaktas, et al (C34) as applied to claims 1 and 22 above, and further in view of Kutay (doctoral dissertation, Applicant's reference "C22"). As set forth above for claims 1 and 22, Ozaktas, et al (*JOSA A* 11(2)), Bernardo, et al (C5), and Ozaktas, et al (C34) disclose the invention substantially as claimed. However, these references do not disclose amplitude distributions or transfer function positions related to (determined by) Hermite function expansions.

In the same field of endeavor, Kutay (C22) discloses a method of filtering in fractional Fourier domains. Kutay teaches that Hermite polynomials are the eigenfunctions of the fractional Fourier transform, and thus that the kernel of the system

optical transfer function can be decomposed into a collection of Hermite polynomials (Eqn. 2.25). Kutay comments (on Page 27) that the transfer function elements can be simple amplitude masks. In identifying an appropriate restoration kernel (Eqns. 3.8, 4.5, 4.6), Kutay notes that when the kernel matrix is Hermitian, the filters are real (-valued; Pg. 48).

It would have been obvious to one of ordinary skill in the art to employ Hermite function expansions in synthesizing the appropriate transfer function element ("mask") locations and amplitude distributions, since Kutay (C22) teaches that such amplitude masks are associated with a kernel matrix which is Hermitian, and teaches that Hermite polynomials are the eigenfunctions of the fractional Fourier transform. That is, Kutay (C22) fairly suggests decomposition of the linear system into a collection of Hermite polynomials.

Allowable Subject Matter

Subject to the rejection under 35 U.S.C. §112, first paragraph, claims 17 and 38 appear to be drawn to allowable subject matter, since the prior art fails to disclose or fairly suggest *the combination* wherein the original image comprising a particle beam, as recited in these claims.

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

FUJI PHOTO FILM (JP 06-131484 A) disclose a monolithic integrated optical system for optical computing and suggest integration as means to reduce system size.

A. Sahin, et al (*Optics Comm.*) disclose a bulk-optical (free-space) implementation of the fractional Fourier transform.

Ozaktas and Mendlovic (*JOSA A* 12(4)) provide further discourse on the relationship between the fractional Fourier integral, Wigner rotation, wavelet transforms, and the Fresnel integral.

P. Pellat-Finet (*Optics Lett.*) discusses the relationship between the fractional Fourier transform and Fresnel diffraction.

A. Lohmann (*JOSA A* 10(10)) discusses the relationship between the fractional Fourier transform and Wigner rotation.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Examiner Juba whose telephone number is (571) 272-2314. The examiner can normally be reached on Mon.-Fri. 9 - 5.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mr. Drew Dunn can be reached on Mon.- Thu., 9 - 5.

The centralized fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306 for *all* communications.

John Juba

JOHN JUBA, JR.
PRIMARY EXAMINER
Art Unit 2872

April 30, 2004